NO ICHTHYOSAURS IN THE UPPER CRETACEOUS OF NEW JERSEY . . . OR SASKATCHEWAN

Donald Baird

Museum of Natural History, Princeton University
Princeton, New Jersey 08544

Abstract

Two anomalously late records of the reptilian order Ichthyosauria in North America, each based on an isolated "coracoid" unaccompanied by any other diagnostically ichthyosaurian bones, are reexamined. The supposed coracoid from the uppermost New Egypt Formation (late Maestrichtian) of New Jersey is reinterpreted as a plesiosaurian pubis, probably assignable to the contemporary genus *Cimoliasaurus*. The supposed coracoid from the Bearpaw Shale (late Campanian) of Saskatchewan is reinterpreted as a plesiosaurian ischium. These finds postdate by some 30 and 25 million years, respectively, the latest unequivocal record of an ichthyosaur in North America (*Platypterygius americanus* from the earliest Cenomanian of Wyoming). Thus the survival of the Ichthyosauria into the post-Cenomanian stages of the Upper Cretaceous remains to be demonstrated.

Introduction

Scientists and amateurs who have been active in collecting and studying reptile bones from the Cretaceous formations of New Jersey were startled in 1978 by a report--from Canada--of an ichthyosaur bone from the Garden State. As the author, Dr. Chris McGowan of the Royal Ontario Museum in Toronto, is the foremost living authority on the Ichthyosauria, his report had to be taken seriously.

The bone in question had been noticed in the collections of the Yale Peabody Museum by Dr. Dale A. Russell, who brought it to McGowan's attention. Catalogued as YPM 449, it had been collected in 1869 by John G. Meirs, the proprietor of the Cream Ridge Marl Company, who operated a commercial pit-mine near Hornerstown. This locality is presumably identical with "the farm of John Miers [*sic, errore*], on Lahaway creek, near Hornerstown, Upper Freehold township, Monmouth county" where the marl deposit was described and analyzed by State Geologist Henry D. Rogers (1840, pp. 261-262). According to Rogers, "excellent marl is seen in two layers, the top one being a light green, with little or no white encrustation upon the grains, and this graduating into the inferior, or dark green marl, which seems to be rather less friable and considerably more ferruginous." He gives the composition of the upper layer as 84.5% greensand, 14.5% clay, and 1.0% quartzose sand; that of the lower layer as 77.45% greensand, 22.55% clay, and no quartzose sand. From subsequent investigation by Olsson (1963) we can identify the upper layer as the Hornerstown Formation and the lower one as the New Egypt Formation (in this area the "Redbank" of earlier authors). In November of 1869 O. C. Marsh described a number of mosasaurs that had recently been collected by Meirs near Hornerstown and that have numbers close to YPM 449 in the Yale catalogue: *Mosasaurus princeps*, YPM 430; *M. meirsii*, YPM 443; *Halisaurus platyspondylus*, YPM 444; *H. fraternus*, YPM 445 (catalog numbers *fide* Russell, 1967). All these specimens are stated to have come from the "lower marl bed," *i.e.*, the New Egypt Formation. David C. Parris has recently examined YPM 449 and informed me that the matrix adhering to the bone is dark and clayey: this is sufficient evidence that, like the mosasaurs, it comes from the New Egypt.

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The upper part of the New Egypt Formation at Hornerstown is a lateral equivalent of the Redbank Formation and is late Maestrichtian (Olsson, 1963; Petters, 1976). Thus the purported ichthyosaur bone from Hornerstown is some 30 million years younger than the geologically latest occurrence of undoubted ichthyosaurs in North America.

Doubts Arise

Among New Jerseyans skepticism about the validity of McGowan's report was aroused by three considerations: the history of collecting, the nature of the specimen, and its anomalously late age.

1. The discovery of reptile bones in the Cretaceous of New Jersey dates back to at least 1787 (Simpson, 1942). Collecting became active in the 1830s with the development of the greensand-mining industry, and continues to this day, although only a single commercial marl-pit is still in operation. For the past 150 years an informal network of dedicated amateurs has been alert to retrieve miners' finds and transmit them to scientists at the American Philosophical Society, the Academy of Natural Sciences of Philadelphia, and the colleges at New Haven and Princeton. Since 1835 the State Geological Survey has been intermittently active in collecting, its fossils being divided between Rutgers University and the New Jersey State Museum. In recent years the Science Bureau of the State Museum, represented by David C. Parris, has been collecting on a weekly basis at the Inversand Company's Sewell pit, the last-remaining commercial operation. Nearly every weekend the brooks of Monmouth County are prospected by fossil-hunters, the most professional of whom are affiliated with the Monmouth Amateur Paleontologists Society or the Delaware Valley Paleontological Society. Despite all this activity by amateurs and professionals during the better part of two centuries, no ichthyosaurian remains have been recovered--except for the single bone identified as an ichthyosaur coracoid by McGowan.

2. A longipinnate ichthyosaur has only two coracoids but it has 46 to 50 presacral vertebrae plus an equal or larger number of caudals (McGowan, 1974). Its vertebral centra are characteristic in form and readily recognized. These chunky, discoidal bones are highly resistant to abrasion, reworking, weathering, and all the other destructive forces of taphonomy. If ichthyosaurs had been present in the littoral Cretaceous of New Jersey they would surely have left us at least *one* centrum as a testimonial. The same argument applies to the characteristic teeth and polygonal paddle-bones of ichthyosaurs: where are they?

3. The anomalously late date of the supposed ichthyosaur bone from Hornerstown is cause for concern. The Ichthyosauria had their beginnings in the Triassic, proliferated and became increasingly cosmopolitan in the Jurassic, and then declined precipitously. According to McGowan (1972, 1974) all Cretaceous records of the group can be referred to a single cosmopolitan genus, *Platypterygius*. Adequate specimens document the range of this genus through the Lower Cretaceous and the initial, Cenomanian stage of the Upper Cretaceous. Its latest occurrence in Europe is the type of *Platypterygius campylodon* from the Lower Chalk (Cenomanian) of Cambridgeshire; in North America, a skeleton of *P. americanus* from the Belle Fourche Shale (earliest Cenomanian) of Wyoming (Nace, 1939, 1941; Romer, 1968). Only two other records of post-Cenomanian ichthyosaurs appear in the literature: an isolated centrum from the Dandaragan Chalk of Western Australia, tentatively dated as Santonian but possibly as old as Aptian (McGowan, 1972); and an isolated coracoid from the Bearpaw Formation (late Campanian) of Saskatchewan (McGowan, 1973). The latter report is reexamined below.

None of these arguments taken singly, of course, is sufficient to disprove the occurrence of ichthyosaurs in New Jersey; but taken together they seem weighty enough to shift the burden of proof onto the advocate's shoulders.

The New Jersey "Coracoid"

The weathered condition of the specimen from Hornerstown, YPM 449 (Fig. 1A), makes interpretation difficult. McGowan (1978) was unable to determine which side is dorsal and, therefore, whether the element belongs to the left or the right side. He found a general congruence between the bone's features and those of ichthyosaurian coracoids, but stated that "the present coracoid is so different from that of P[*latypterygius*] *americanus* that I would not refer it to the same genus." As *Platypterygius* is the only ichthyosaur genus recognized by McGowan in the Cretaceous worldwide, his statement in effect postulates a second genus represented by a single bone that postdates by some 30 million years the latest unequivocal record of *Platypterygius* in North America. A suspension of disbelief seems necessary. It should be noted, however, that the comparison made was not with skeletons of *P. americanus* (all of which lack the coracoids) but with an isolated bone from Saskatchewan that he had identified as a coracoid and assigned on general principles to *P. americanus*. In my opinion (see below) that bone is neither ichthyosaurian nor a coracoid.

When received at the Peabody Museum in 1869 the bone from Hornerstown was identified, presumably by O. C. Marsh, as belonging to the plesiosaur *Cimoliasaurus*. This genus had been described from the greensands of New Jersey by Leidy in 1851 on the basis of thirteen vertebrae;

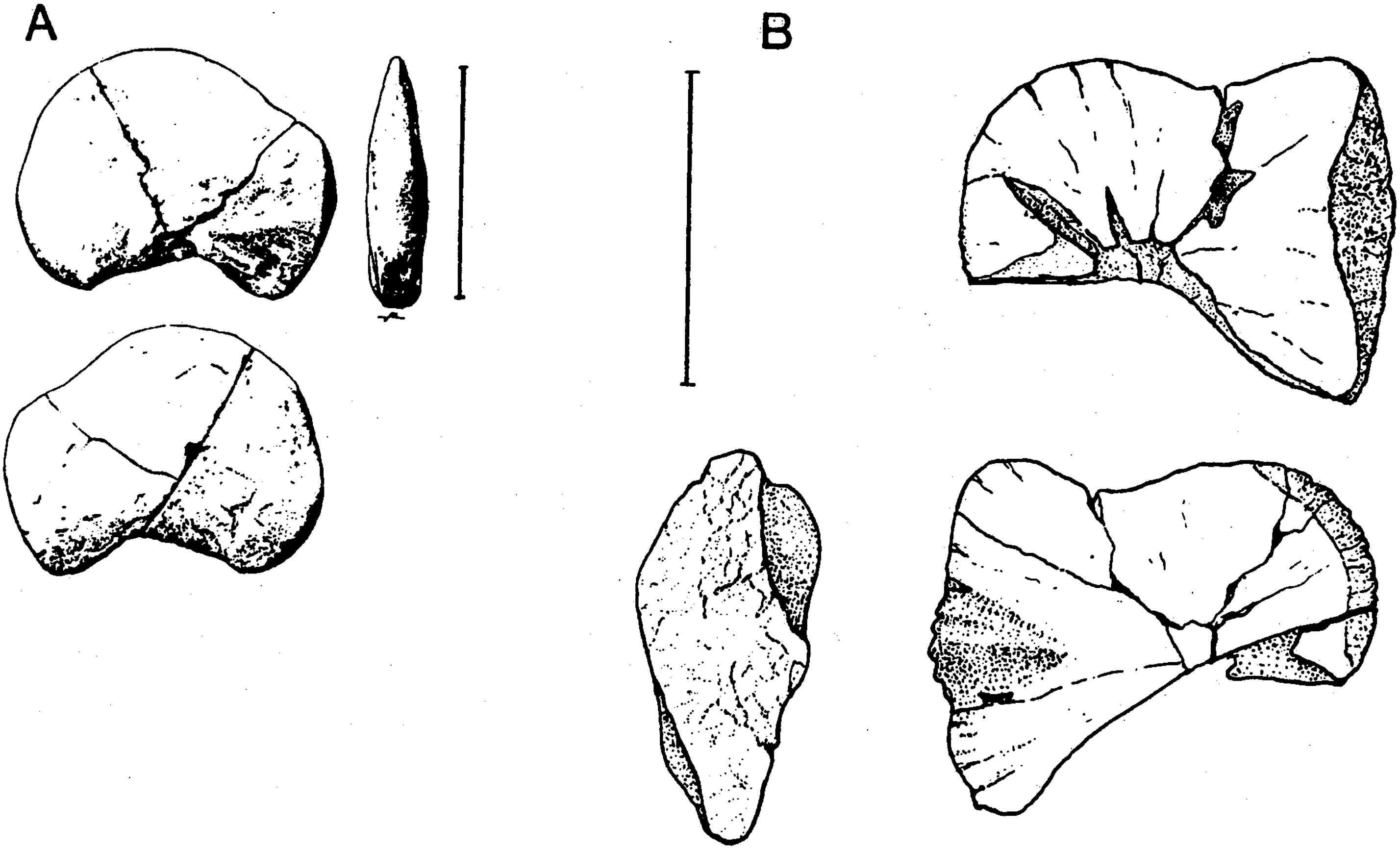

Figure 1. *A*, putative ichthyosaur coracoid from the uppermost New Egypt Formation of Hornerstown, New Jersey (YPM 449, Yale Peabody Museum), here reinterpreted as a plesiosaur pubis (from McGowan, 1978). *B*, putative coracoid of *Platypterygius americanus* from the Bearpaw Formation of Saskatchewan (NMC 21857, National Museum of Canada), here reinterpreted as a plesiosaur left ischium (from McGowan, 1973). Scale bars measure 10 cm.

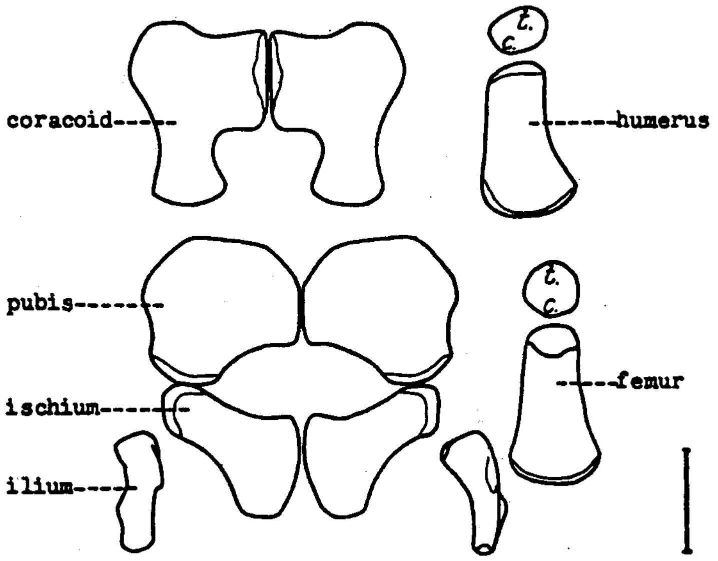

Figure 2. *Fresnosaurus drescheri* (type specimen), dorsal view of coracoids and pelvic girdle, with humerus and femur (from Welles, 1943). Scale bar measures 10 cm.

subsequent finds (all fragmentary) have been reviewed by Parris (1974), who assigned the genus tentatively to the pliosaurid family Polycotylidae. As Parris noted, the source formations of most 19th-century specimens are uncertain, and only one (the type of *Plesiosaurus brevifemur* Cope) can be documented as coming from the basal Hornerstown Formation. Other specimens have been found in the upper levels of the underlying New Egypt Formation ("Navesink" of authors) as well as in the Navesink-proper. If correctly assigned these specimens indicate a generic range from early to latest Maestrichtian. As YPM 449 cannot pertain to any mosasaur, sea-turtle, crocodilian, or dinosaur, a plesiosaur such as *Cimoliasaurus* becomes by elimination the most obvious candidate for comparison.

Although the girdle bones of *Cimoliasaurus* are unknown, a survey of other Maestrichtian plesiosaurs reveals several in which the *pubis* bears a marked resemblance to YPM 449. (See Fig. 2.) *Fresnosaurus* (Welles, 1943, pp. 181-183, fig. 27) from the Moreno Formation of California has "pubes convex anteriorly, with posterointernal concavity much longer than posteroexternal, not projecting posteriorly in midline to form pelvic bar." This description neatly fits the Hornerstown bone if McGowan's "intercoracoid facet" is reinterpreted as the interpubic facet, his "scapular facet" as the ischial facet, and his "glenoid" as the acetabulum; the outlines of the bones are strikingly similar. Also comparable but less similar are the pubes of *Aphrosaurus* (Welles, 1962, fig. 18) from the Moreno of California, *Leurospondylus* (Brown, 1913) from the Edmonton Formation of Alberta, and an undetermined juvenile elasmosaurid from the Haumuri Beds of New Zealand (Welles & Gregg, 1971, fig. 16). These comparisons indicate that YPM 449 is a plesiosaur pubis, and that its original identification as *Cimoliasaurus* was probably correct.

The Saskatchewan "Coracoid"

The spirit of revisionism, once aroused, prompts us to take another look at the reported ichthyosaur coracoid from Saskatchewan. According to McGowan (1978) this bone (Fig. 1B) was found in the Bearpaw Formation (late Campanian) of the South Saskatchewan River valley. Although 21 mosasaur specimens have been collected from the same formation and area, no other ichthyosaur remains are known from there. McGowan admitted to difficulty in orienting the specimen and determining whether it belongs to the left or right side. He assigned it to *Platypterygius americanus* (Nace), a species that is represented by partial skeletons from the upper Mowry Shale Member of the Graneros Formation (late Albian) and the Belle Fourche Member of the Graneros (earliest Cenomanian) of Wyoming--specimens that had been redescribed in his 1972 paper. (These are the geologically youngest occurrences of *diagnostic* ichthyosaurian material in North America.) As the coracoid is not present in any of the three Wyoming specimens, no direct comparisons could be made; but McGowan concluded, "As NMC 21857 is not inconsistent with what is known of the coracoid of *Platypterygius*, and as it is from North America, it is referred to *P. americanus*." This reasoning seems somewhat lacking in rigor.

As in the case of the New Jersey specimen the solitary occurrence of the bone from Saskatchewan invites suspicion, since (as noted above) for every ichthyosaur coracoid we should expect to find 50 vertebral centra. The temporal gap of some 25 million years that separates the Saskatchewan find from the Wyoming skeletons is not an insuperable objection in itself; yet the anomalous nature of the occurrence suggests that an alternative interpretation should be sought. Could the supposed ichthyosaur coracoid from Saskatchewan, like the one from New Jersey, be a plesiosaur girdle bone instead? Indeed it could.

Comparison with the pectoral and pelvic girdles of Cretaceous plesiosaurs, usefully brought together in one illustration by Welles (1962, fig. 23) shows several genera in which the *ischium* is closely comparable to NMC 21857, if McGowan's "intercoracoid facet" is reinterpreted as the interischial facet and his "scapular facet" as the confluent pubic facet and acetabulum. The left ischium of *Fresnosaurus* (Welles, 1943, fig. 27) from the Moreno Formation of California affords the closest comparison (see Fig. 2), with *Brancasaurus* (Welles, 1962, fig. 8) from the Wealden of Germany and *Alzadasaurus riggsi* (Riggs, 1939, fig. 111; Welles, 1943, fig. 30) from the Benton Formation of Montana being somewhat less similar. NMC 21857 is accordingly reidentified as the left ischium of a plesiosaur, although its generic identity must remain uncertain until more diagnostic material becomes available.

The transfer of these two specimens to the Plesiosauria eliminates the putative post-Cenomanian record of the Ichthyosauria. Survival of the ichthyosaurs beyond the earliest stage of the Upper Cretaceous remains to be demonstrated.

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References

BROWN, B. 1913. A new plesiosaur, *Leurospondylus*, from the Edmonton Cretaceous of Alberta. *Am. Mus. Natural History Bull.*, 32(40):605-615.

MARSH, O. C. 1869. Notice of some new mosasaurid reptiles from the greensand of New Jersey. *Am. Jour. Science*, 48:392-397.

McGOWAN, C. 1972. The systematics of Cretaceous ichthyosaurs with particular reference to the material from North America. *Univ. Wyoming Contrib. Geology*, 11(1): 9-29.

———. 1973. A note on the most recent ichthyosaur known: an isolated coracoid from the Upper Campanian of Saskatchewan (Reptilia, Ichthyosauria). *Canadian Jour. Earth Science*, 10(8):1346-1349.

———. 1974. A revision of the longipinnate ichthyosaurs of the Lower Jurassic of England, with descriptions of two new species (Reptilia: Ichthyosauria). *Royal Ontario Mus., Life Sciences Contrib.*, 97:1-37.

———. 1978. An isolated ichthyosaur coracoid from the Maastrichtian of New Jersey. *Canadian Jour. Earth Science*, 15(1):169-171.

NACE, R. L. 1939. A new ichthyosaur from the Upper Cretaceous Mowry Formation of Wyoming. *Am. Jour. Science*, 237:673-686.

———. 1941. A new ichthyosaur from the Late Cretaceous, northeast Wyoming. *Am. Jour. Science*, 239:908-914.

OLSSON, R. K. 1963. Latest Cretaceous and earliest Tertiary stratigraphy of New Jersey coastal plain. *Am. Assoc. Petroleum Geologists Bull.*, 47(4):643-665.

PARRIS, D. C. 1974. Additional records of plesiosaurs from the Cretaceous of New Jersey. *Jour. Paleontology*, 48 (1):32-35.

PETTERS, S. W. 1976. Upper Cretaceous subsurface stratigraphy of Atlantic Coastal Plain of New Jersey. *Am. Assoc. Petroleum Geologists Bull.*, 60(1):87-107.

RIGGS, E. S. 1939. A specimen of *Elasmosaurus serpentinus*. *Field Mus. Natural History, Geol. Ser.*, 6(25):385-391.

ROGERS, H. D. 1840. *Description of the geology of the State of New Jersey, being a final report.* Philadelphia: C. Sherman & Co., pp. 1-301.

ROMER, A. S. 1968. An ichthyosaur skull from the Cretaceous of Wyoming. *Univ. Wyoming Contrib. Geology*, 7(1): 27-41.

RUSSELL, D. A. 1967. Systematics and morphology of American mosasaurs. *Yale Univ., Peabody Mus. Natural History Bull.*, 23: i-vii, 1-241.

SIMPSON, G. G. 1942. The beginnings of vertebrate paleontology in North America. *Am. Philos. Soc. Proc.*, 86(1):130-188.

WELLES, S. P. 1943. Elasmosaurid plesiosaurs with description of new material from California and Colorado. *Univ. California Mem.*, 13(3):125-254.

————. 1962. A new species of elasmosaur from the Aptian of Colombia and a review of the Cretaceous plesiosaurs. *Univ. California Pub. Geol. Sciences*, 44(1):1-96.

WELLES, S. P., & D. R. GREGG. 1971. Late Cretaceous marine reptiles of New Zealand. *Canterbury Mus. Rec.*, 9(1): 1-111.